REMARKS

Claims 8, 9, 11-13, and 19-25 are currently pending in the application. No claims have been amended or added. Applicant respectfully requests reconsideration of the application in view of the following remarks.

I. Introduction

In the *Response to Arguments* section, the Office Action states that "When considering the combined teaching value of Barthelemy and Collins, one of ordinary skill in the art would have seen the benefits of using small world principles to construct scalable computer systems." Applicant respectfully disagrees with this assertion. Neither Barthelemy nor Collins suggests the application to scalable multiprocessing computer systems. Nothing in Barthelemy or Collins, or any other prior art document of record, remotely suggests the possibility that a massively scalable computing system may be constructed, in which a desired average path length between nodes may be achieved independently of a number of computing nodes.

The Office Action further states that one of ordinary skill in the art "would have had no difficulty implementing them." Again, Applicant respectfully disagrees with this assertion. In fact, contrary to the above quotation, Collins states, "Strategies for determining and achieving optimal small-world connectivity remain to be developed." (p. 410). Only the present application shows the results that are achievable using the particular method and structure claimed, on scales to the order of at least hundreds of millions of individual processors.

Applicant has maintained, throughout the Office Actions, that no prior art has been identified that includes any disclosure regarding the application of the so called "small world" principle to the design and construction of massively scalable multiprocessing computing systems.

For example, early Office Actions relied primarily upon Annapareddy, by itself and in view of Watts and/or Brewer, as disclosing a network having "small world" characteristics. Applicant amended the claims in response, to clarify the particular clustering approach of the invention which contributes particularly to the achievement of massive scalability, and subsequently, following a useful interview with the Examiner, to define the invention in alternative terms of a method of design or construction. However, a further Office Action

maintained rejections based upon Annapareddy and Watts, and introduced new rejections based upon Barthelemy. Applicant maintains that none of these references teach or suggest the practical application of "small world" principles to massively scalable multiprocessing computing systems.

Applicant further amended the claims to clarify details of an iterative optimization process, in response to useful feedback from the Examiner, which resulted in withdrawal of the Annapareddy reference. However, the amended claims were rejected as being unpatentable over Barthelemy in view now of Collins. Applicant maintains that Collins also fails to teach or suggest the practical application of "small world" principles to massively scalable multiprocessing computing systems.

Nonetheless, and again on helpful suggestion of the Examiner, Applicant has amended the claims to more clearly recite specific structure of the inventive scalable computing system, including the use of a particular switching architecture. The present Office Action has cited the Attanasio reference as providing the claim limitations not present in Barthelemy and/or Collins. Applicant however maintains that none of the cited references teach or suggest the practical application of "small world" principles to massively scalable multiprocessing computing systems, or indeed make any mention whatsoever of such systems.

Accordingly, while there are suggestions in some of the prior art references (*e.g.* by Barthelemy and Collins) that the small world approach might be applied to improve performance of communications networks, including computer networks such as the Internet, the prior art fails to provide a single concrete example demonstrating precisely how this may be achieved.

By contrast, the instant invention, as defined in the presently pending claims, provides a specific method for constructing a massively scalable computer system, as well as the resulting specific structure of such a computer system, and the specification expressly discloses the massive scalability that may thereby be achieved. This is simply not disclosed or suggested in the prior art, nor is it a predictable result of combining the disclosures in the prior art references presently relied upon in the Office Action.

Applicant respectfully submits that prior art references are being added in a piecemeal manner with the full benefit of hindsight. The Court in *KSR* stated, "a fact finder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex-post* reasoning." (Slip op. at 17.) Applicant respectfully asserts that

none of the prior art includes any teaching or suggestion of the application of small world principles to the design, construction or operation of massively scalable computer systems. It is only with the benefit of having read the present specification that it is possible to draw the various inferences leading from the prior art to the invention as presently claimed.

For example, it is the inventor's own inventive insight, and not a teaching or suggestion of the prior art, that a network of clusters of computing nodes, interconnected in accordance with small world principles, using a specific optimization strategy such that an average path length between the nodes falls within a predetermined desired range independently of the number of computing nodes, enables massive scalability on the order of hundreds of millions of individual processors.

II. Claim Rejections

Claims 8, 9, 11-13, and 19-24 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Barthemely ("Small Worlds Networks: Evidence for a Crossover Picture") in view of Collins ("It's a small world") further in view of Attanasio *et al.* (U.S. Pat. 5,371,852).

To summarize the cited references, Barthelemy and Collins teach that small world networks have interesting properties which, it has been suggested, may enable improvements in performance of telecommunications networks, and computer networks such as the Internet. Attanasio teaches that processing nodes may be organized into clusters, and that the clusters may be configured so as to emulate a single, higher-powered, computing node. Attanasio discloses a method and apparatus for enabling a cluster of computers to appear as a single computer to host computers outside the cluster. That is, Attanasio teaches that a group of interconnected computing nodes may be configured so as to appear externally to be a single computing node. It is not an object of Attanasio to address issues of scalability. Rather, Attanasio is concerned with problems that arise when known clusters are reconfigured, for example to add or remove processing nodes (*See* Attanasio col. 3 line 42 to col. 4 line 39).

In *KSR,* the court stated that "the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." (Slip op. at 12.) The predictable results of combining the teachings of Barthelemy, Collins, and Attanasio is therefore the construction of a network of computing node clusters, in which each

cluster appears to be a single computing node, and wherein efficient communications is achieved between the clusters. However, this combination increases the overall computing power of the network only by a factor equal to the number of nodes in each cluster. The combination does not teach any method of organizing the clusters, or the connections between clusters, in order to achieve massive scalability on the order of hundreds of millions of individual processing nodes. This degree of scalability is wholly surprising and unpredictable. The present specification teaches exactly, for the first time, how it may be achieved. Furthermore, this particular method and the resulting structure, as claimed, are not taught or suggested in the prior art references.

While it is arguable that Barthelemy, Collins, and Attanasio may provide "pieces of the puzzle," they do not provide an implementation capable of achieving the wholly remarkable results of the present invention. In particular, none of the cited reference teach or suggest the specific combination of features defined by independent claim 8, comprising a network of crosslinked computing node clusters, each cluster of nodes being interconnected via a common switch, "wherein the crosslinks are disposed such that the pairs of node clusters form a network of said plurality of computing nodes which has a higher clustering coefficient of nodes in comparison with a corresponding randomly connected network, in combination with a lower characteristic path length between the nodes in comparison with a corresponding regularly connected network, and wherein said network comprises a small world network having an average path length between the nodes falling within a predetermined desired range, independently of a number of said plurality of computing nodes."

When considered as a whole, the presently claimed invention combines prior art elements in a completely new way, achieving a synergy that results in a scalable multiprocessing computing system that is able to support from a few nodes up to hundreds of millions of processing nodes with no appreciable communications or performance limitation. This is a wholly surprising and unpredictable result, that cannot be derived from the prior art, which would lead one to expect only a modest improvement in scale and/or performance.

For all the foregoing reasons, Applicant respectfully submits that independent claim 8 distinguishes over the cited combination of Barthemely, Collins, and Attanasio *et al.* and is in condition for allowance.

Dependent claims 9, and 11-13 depend from and further restrict independent claim 8 in a patentable sense. Applicant respectfully submits that, for at least the reasons set forth above

with respect to the rejection of independent claim 8, dependent claims 9 and 11-13 distinguish over the cited combination of Barthemely, Collins, and Attanasio *et al.* and are in condition for allowance.

For at least the reasons given with respect to independent claim 8, Applicant respectfully submits that independent claim 19 distinguishes over the cited combination of Barthemely, Collins, and Attanasio *et al.* and is in condition for allowance.

Dependent claims 20-24 depend from and further restrict independent claim 19 in a patentable sense. Applicant respectfully submits that, for at least the reasons set forth above with respect to the rejection of independent claim 19, dependent claims 20-24 distinguish over the cited combination of Barthemely, Collins, and Attanasio *et al.* and are in condition for allowance.

Claim 25 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Barthemely in view of Collins further in view of Attanasio *et al.* further in view of Brewer (U.S. Pat. No. 5,859,975). Claim 25 depends from and further restricts independent claim 19 in a patentable sense. Applicant respectfully submits that, for at least the reasons set forth above with respect to the rejection of independent claim 19, dependent claim 25 distinguishes over the cited combination of Barthemely, Collins, and Attanasio *et al.* Applicant further submits that Brewer does not cure the above mentioned deficiencies of the cited combination of Barthemely, Collins, and Attanasio *et al.* For at least these reasons, claim 25 distinguishes over the cited combination and is in condition for allowance.

In view of the above, Applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

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